US009665095B1

(12) **United States Patent**
Romano et al.

(10) **Patent No.: US 9,665,095 B1**
(45) **Date of Patent: May 30, 2017**

(54) **SYSTEMS AND METHODS FOR REMOVING DEBRIS FROM WAREHOUSE FLOORS**

(71) Applicant: **Amazon Technologies, Inc.**, Seattle, WA (US)

(72) Inventors: **Joseph Romano**, Seattle, WA (US); **Peter R. Wurman**, Acton, MA (US); **Dennis Polic**, North Reading, MA (US); **Peter K. Mansfield**, Bellevue, WA (US)

(73) Assignee: **Amazon Technologies, Inc.**, Seattle, WA (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 120 days.

(21) Appl. No.: **14/662,893**

(22) Filed: **Mar. 19, 2015**

(51) **Int. Cl.**

G05D 1/00	(2006.01)
G05D 3/00	(2006.01)
G06F 7/00	(2006.01)
G06F 17/00	(2006.01)
G05D 1/02	(2006.01)
B25J 11/00	(2006.01)
A47L 11/24	(2006.01)

(52) **U.S. Cl.**
CPC ***G05D 1/0038*** (2013.01); ***A47L 11/24*** (2013.01); ***B25J 11/0085*** (2013.01); ***G05D 1/0246*** (2013.01); ***G05D 1/0282*** (2013.01); *A47L 2201/04* (2013.01); *A47L 2201/06* (2013.01); *Y10S 901/01* (2013.01); *Y10S 901/47* (2013.01)

(58) **Field of Classification Search**
CPC .. G05D 1/0038; G05D 1/0246; G05D 1/0282; B25J 11/0085; A47L 11/24; A47L 2201/06; A47L 2201/04; Y10S 901/01; Y10S 901/47
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

4,783,904	A	11/1988	Kimura	
6,678,583	B2	1/2004	Nasr et al.	
6,883,201	B2 *	4/2005	Jones	A47L 5/30 15/319
7,039,499	B1	5/2006	Nasr et al.	
7,093,318	B2 *	8/2006	Konrad	A47L 1/02 15/301
7,448,113	B2	11/2008	Jones et al.	
8,239,992	B2	8/2012	Schnittman et al.	
9,215,962	B2	12/2015	Qian	
2004/0049877	A1 *	3/2004	Jones	A47L 5/30 15/319

(Continued)

Primary Examiner — Jaime Figueroa
(74) *Attorney, Agent, or Firm* — Lee & Hayes, PLLC

(57) **ABSTRACT**

Robots or other machines may be used for retrieving errant objects from the floor of an automated warehouse. A system can include one or more reporting methods to alert a central control to the existence and location of an object on the warehouse floor. The central control can establish a safety zone around the object to avoid contact with normal warehouse traffic (e.g., standard warehouse robots). The system can route a cleanup robot to the location to retrieve the object. The system can include a cleanup pod comprising a convertible shelving unit with a robotic arm. The cleanup pod can have a similar form factor as shelving units used for storing inventory in the warehouse, thereby enabling standard warehouse robots to lift and transport the cleanup pod to retrieve an object.

20 Claims, 20 Drawing Sheets